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ABSTRACT

A project was conducted to evaluate the effectiveness of the stress-management training given to students in the jumpmaster training course at Fort Benning, Georgia. The course, which trains airborne personnel to conduct landings of men and equipment, features relatively stressful training programs during which instructors grade the performance of students' activity as jumpmasters for actual airdrops. To gather data for the study, researchers divided one class of 31 jumpmaster students into pairs matched by rank. Members of each pair were then randomly assigned to either the experimental or control group. Besides receiving the same regular training that the control group received, the experimental group was taught a method of respiration control to be used immediately before and during training jumps. The groups were then compared on the basis of heart rate during 2-day and 2-night training jumps, a self-reported measure of perceived stress during the jumps, and grades received for performance as jumpmasters during 1-day and 1-night jumps. Members of the experimental group had significantly lower heart rates during the 2-night jumps of the course, jumps that, because of limited visibility, are somewhat more dangerous and more stressful than daylight jumps. (MN)

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Technical Report 550

AN EXPERIMENTAL EVALUATION OF STRESS-MANAGEMENT TRAINING FOR THE AIRBORNE SOLDIER

ED242928

William P. Burke

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The Jumpmaster Course at Fort Benning, Georgia, trains airborne personnel to conduct airdrops of men and equipment and features relatively stressful training jumps during which instructors grade the performance of students acting as jumpmasters for actual airdrops.

One class of Jumpmaster students was divided into pairs matched by rank and the members of each pair were randomly distributed into either an experimental or a control group. The experimental group was taught a method of stress management, respiration control, to be used immediately before (con't)

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and during training jumps. The groups were then compared on heart rate, perceived stress, and grades received for performance as jumpmasters during training jumps.

The results showed that the experimental groups had significantly lower heart rates during the two night jumps of the course -- jumps which, because of limited visibility, are somewhat more dangerous and therefore more stressful than daylight jumps. There were no other statistically significant differences between the groups.

Technical Report 550

AN EXPERIMENTAL EVALUATION OF STRESS-MANAGEMENT TRAINING FOR THE AIRBORNE SOLDIER

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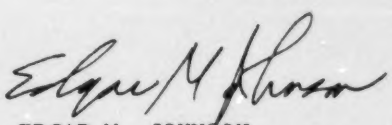
FOREWORD

The U.S. Army Research Institute (ARI) Field Unit at Fort Benning, Georgia, is strategically located at one of the centers of airborne training for the United States military and has ready access to numerous individuals who are undergoing the stresses of parachute jumping and related activities. This report describes an experimental evaluation of the effects of respiration control, a stress-management technique, on stress and performance in the Jumpmaster Training Course at Fort Benning.

The research was funded by ARI's In-House Laboratory Independent Research Program (ILIR), and was made possible by the generous cooperation of the Director of the Airborne Department at Fort Benning, COL Joseph A. Villa. Special assistance to this project was provided by CPT Fred Berger and MAJ Stephen R. Pullen, each of whom served in his turn as Operations Officer of the Airborne Department. Invaluable support and assistance were provided by SFC Joe Wood, Chief of the Jumpmaster Training Branch, and his cadre of Jumpmaster instructors.



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AN EXPERIMENTAL EVALUATION OF STRESS-MANAGEMENT TRAINING FOR THE AIRBORNE SOLDIER

BRIEF

Objective:

To determine whether any presently available methods of stress-management training are appropriate for use by airborne soldiers in stressful situations and, if so, to select one and evaluate its effectiveness in an operational setting.

Procedure:

The research was conducted in two phases. In Phase I, a literature search was done to identify methods of stress-management training that are well-validated by evidence attesting to their effects and that give promise of being adaptable for use by the airborne. Several promising techniques were found and the method finally chosen for evaluation was respiration control, a pattern of deep, slow breathing that has been found in both laboratory and field research to reduce the heart rate, a prime indicator of stress, as much as 30 beats per minute.

In Phase II, an evaluation experiment was conducted on respiration control using the students of one class of the Jumpmaster Training Course at Fort Benning, Georgia. The Jumpmaster Course trains airborne personnel to prepare and supervise airdrops of men and equipment and features relatively stressful training jumps during which instructors grade the performance of the students while they serve as jumpmasters for actual airdrops.

The class was divided into pairs matched by rank and the members of each pair were randomly distributed into either an experimental or a control group. The final groups contained nine men in each. Both the experimental and the control groups went through the regular training program but the experimental group was, in addition, taught a method of respiration control to be used immediately before and during training jumps. The groups were then compared on heart rate during four training jumps (two during the day and two at night), a self-report measure of perceived stress during the four jumps, and grades received for performance as jumpmasters during one day and one night jump.

Findings:

The results showed that the experimental group had significantly lower heart rates during the two night jumps of the course - jumps which, because of limited visibility, are somewhat more dangerous and therefore more stressful than daylight jumps. There were no statistically significant differences on any of the other measures, although, with the exception of performance on the graded night jump, the experimental group did slightly better, on average

(lower heart rates and perceived stress and fewer points lost) than the control group on all measures.

Utilization of Findings:

This research indicates that respiration control can help to lower the heart rate of individuals in stressful situations. What influence the technique may have on performance under stress, however, is still an open question. Further research is necessary to establish the most effective rate and pattern of breathing for use under operational conditions. The slightly better performance of the experimental group relative to the controls on 9 out of 10 of the measures taken in this experiment also suggests that continued research on the technique would be warranted. Subsequent research should be done on either a much larger sample of the experienced and relatively stress-resistant students from the Jumpmaster Course or, if suitable performance measures can be devised, on the less experienced and relatively stress-susceptible men making their first jumps in the Basic Airborne Course.

AN EXPERIMENTAL EVALUATION OF STRESS-MANAGEMENT TRAINING FOR THE AIRBORNE SOLDIER

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AN EXPERIMENTAL EVALUATION OF STRESS-MANAGEMENT TRAINING FOR THE AIRBORNE SOLDIER

INTRODUCTION

One of the strongest and most persistently valid arguments for the continued existence of the airborne division is its great strategic flexibility and "reach" - its capacity to be deployed on short notice anywhere in the free world to fulfill various missions important to this country and its allies (Hessman and Schemmer, 1968a; Parsons 1972; Cecil, 1977). Indeed, the very first U.S. Airborne unit to be dropped into combat, jumped into North Africa in World War II from a staging area far back in England (Hessman and Schemmer 1968b). It is, in fact, this capacity for global strategic movement that is the hallmark of the airborne division and the principal advantage which it holds over its younger rival, the airmobile division, whose helicopter transports have far shorter "reach" with which to deploy troops.

There is, however, a serious problem inherent in this very important ability to transport troops to distant battle areas. The problem derives from the fact that it is men, not just equipment, that are transported so far to the critical point of decision, and that men have certain physiological and psychological limits to their ability to perform at their maximum. The problem has been most forcefully stated by COL Robert Bernstein, a U.S. Army Medical officer, who points out that "... the often taken-for-granted concept that any force can be moved anywhere on earth almost without notice, alight with weapons firing, and engage the enemy in sustained combat reflects frank overoptimism, and could be dangerously unrealistic (Bernstein, 1964, p. 72)." One of the reasons for this overoptimistic expectation of almost machine-like performance from men of the strategic force is that little acknowledgement is given to the weakening effects on the troops of the long flight to the objective area, at the end of which is a jump into an uncertain or definitely hazardous battlefield situation. It is during this long but relatively inactive period that the soldier anticipates the upcoming struggle, reviews his plans for it, and, thus, by his thoughts alone, activates all the physiological and psychological alarm systems of his body and expends all the bodily energy necessary to drive them. Unfortunately, energies expended in anticipation of the fight are energies lost for the actual fight. As COL Bernstein points out "... by the time the jumper hits the ground, he has had enough physical exertion and mental stimulation for an entire day - but his day has not yet started (Bernstein, 1964, p. 77)."

This is a problem long recognized in airborne circles. The Germans in World War II tried to overcome the effects of pre-jump anxiety and loss of vitality in their paratroopers by having them eat high energy foods such as dried fruits and inject themselves with various stimulants

such as caffein (Bernstein, 1964). American paratroopers also, apparently, were fortified with chemical stimulants prior to the D-Day drop into Normandy (Burgett, 1968).

However, this problem of high levels of anxiety and its resultant drain on energy is at its base a psychological one. The mind of the soldier dwells on the challenges and dangers to come, activiating his body's "fight or flight" system resulting in a constant expenditure of energy - energy which should be hoarded for the demands of the fight to come.

This, the primary problem, leads to a secondary one - one which also poses a threat to the accomplishment of the airborne mission:

"The sense of relief and the subtle desire for relaxation experienced by the military parachute jumper after reaching the ground are actual and unmistakeable. These sensations ... can be detrimental to the interest of the jumper in combat. When he lands on the drop zone, the parachutist should have at his ready call all the physical strength and mental acuity he can muster. Thus, this drain which takes the form of a sense of accomplishment, a feeling of fatigue, a desire to rest, no matter the degree, serves only to impair his efficiency (Bernstein, 1964, p. 71)." This feeling, without doubt, exerts a subtle resistance to the rapid assembly of units on the drop zone and a speedy movement to accomplish mission objectives.

Similar reactions have been reported for amphibious troops after beach landings (Bernstein, 1964), and it might be thought of as a kind of we-have-landed letdown. It apparently springs from the experience of having been transported through a medium of danger (down by parachute to the drop zone, in under fire by landing craft to the beaches) because of which the individual apparently feels he deserves, as a reward, a period of rest, recuperation, and safety.

If it is true that the two preceding problems, energy drain and letdown, are partly psychological problems, then their solutions should be partially psychological solutions. The underlying cause of both is almost certainly fear. It is fear, obviously, in the first case of anxiety-based energy depletion, because it is fear of anticipated consequences that raises anxiety and puts the body on alert. It is probably fear or rather, the release from fear, also, in the second case of we-have-landed letdown. In that instance, the decline of fear produces relief from anxiety and a resulting standing-down of the body's alarm mechanisms.

If the above relationships actually hold, it should then be the case that any psychological technique which can be applied in the airborne situation and will reduce fear will act also to conserve the energies of the jumpers and reduce the magnitude of the post-jump letdown.

There are presently a number of fairly well-validated techniques currently in use within medical and clinical psychological practice that might be adaptable for use with the airborne. Most of these techniques are forms

of fear-desensitization or relaxation therapies (e.g., Jacobson, 1938; Wolpe, 1973; Benson, 1975; Tutko & Tosi, 1976) which have at their core similar programs of mental and physical exercises designed to calm the mind, shut down the activated alarm mechanisms of the nervous system, and relax the muscles of the body.

Several laboratory experiments have shown that physiological indicators of high levels of anxiety (such as high heart and respiration rates, high blood pressure, and high skin conductance) can be greatly reduced by techniques of deep muscle relaxation (Jacobson, 1938; Paul, 1969) and, in some instances, these decreases in the bodily indicators of anxiety have been accompanied by decrements in the level of perceived anxiety reported by clinical patients (e.g., Wolpe & Fried, 1973).

However, the clearest and most appropriate indication that some form of stress-management technique might be beneficial to the paratrooper comes from an as yet unpublished study from the laboratory of Dr. Walter Fenz of the University of Waterloo in Canada. For several years, Dr. Fenz, himself a skydiver, has been studying sports parachutists and has found, among other things, that individuals who are rated as good performers at free-fall parachuting show a different pattern of heart rate response to the various activities preparatory to a parachute free-fall than do those rated as poor performers (Fenz, 1973; Fenz & Jones, 1972, 1974). He and his associates have found that, while poor performers show a relatively rapid increase of rate of heart beat from the time at which they first arrive at the airport on jump day, through boarding the aircraft, to reaching final altitude for the jump run, the heart rate of good performers peaks when boarding the aircraft and declines, thereafter, during engine warm up and the climb to final altitude. By the time of the jump run over the drop zone their heart rates have declined to the levels at which they stood when the individuals arrived at the airport that morning.

With reference to stress-management training, Dr. Fenz's most important project is one recently completed in collaboration with G. Brian Jones (see Fenz, 1975) in which they developed a program of mental and physical tactics aimed at the control of involuntary stress reactions. In this research, they monitored the heart rate of individuals in two groups of novice parachutists, one group of which received the stress-management training and one of which did not, during their first jumps and during their first free-falls. The two groups showed heart rates which were significantly different after boarding the aircraft for both jumps. The most important aspect of these differences is that the heart rate response of the untrained jumpers resembled that of the poor performers in Fenz and Jones' earlier studies, while the heart rate of the trained group resembled that of the good performers in the prior studies. The training procedures had apparently prepared novice jumpers to approach the most critical of their early jumps in similar physical, and, presumably, mental states, to those of jumpers of far greater experience and ability.

If any of the above methods are effective in controlling fear and its unwelcome effects, it might be possible to apply them to the airborne situation

and the particular problems it presents. This research was done to determine the feasibility of that goal.

OBJECTIVES

The objective of this research was the selection and implementation of a stress-management technique for use with airborne soldiers and it was carried out in two phases. First, in Phase I, the most appropriate and best validated method was selected for adaptation to the specific demands of a particular airborne environment. Subsequently, in Phase II, that method was taught to individuals from that selected airborne environment. Their performance was then compared to that of a control group in an evaluation experiment.

PHASE I

Method

General

A literature search was done to inquire into the current "state of the art" in stress-management and relaxation therapies. Then, from among the best validated stress-management or related techniques currently in use in medical practice, clinical psychology, or sports psychology, the most promising techniques for the purposes of this research were selected by the experimeter for more intense study. Workshops or seminars in each selected method were attended and the technique holding the most promise for a successful transplant to the airborne situation was chosen and adapted for special application.

State of the Art

One of the most remarkable and promising breakthroughs in the recent history of the behavioral sciences has occurred in the past decade in the field of psychosomatic medicine or as it has since come to be known, Behavioral Medicine. This emerging discipline is the result of a collaboration between psychologists and medical doctors, both basic researchers and applied practitioners, all joined in the study of the mind-body interaction and the attempt to influence it.

The study of Behavioral Medicine began to grow in respectability and in numbers of scientists involved following the publication of several important papers during the closing years of the 1960's. For instance, in 1969, Miller published a paper in the journal Science describing his work of many years which indicated that animals could learn to control their

visceral and glandular responses - responses controlled by the autonomic or automatic nervous system, which, theretofore, had been considered impervious to voluntary control. In the same year, Budzynski and Stoyva (1969) published results from their work in which they used a technique called biofeedback to produce muscular relaxation and relief from tension headaches. Biofeedback, briefly described, is the presentation to the individual, through electronic instrumentation, of a display of information about various bodily processes which tells him precisely what state those systems are in and how his efforts to control them are proceeding.

Following these and other landmark publications, research into volitional control of physiological functioning has proliferated and led to a rapid accumulation of reasonably hard scientific evidence attesting to some exciting possibilities in this field. This large and growing body of evidence has not only led to the development of several programs of clinical therapy held in relatively high scientific regard but has also caused the elevation to that status of a number of old to ancient therapies and techniques once universally dismissed in the scientific community as suspect, at best, or hokum, at worst.

A partial listing of these new or scientifically resurrected techniques follows:

Transcendental Meditation (TM). The relatively recent surge in popularity in the West of Transendental Meditation, a modified form of Eastern meditation procedures, has led researchers in this country to inquire into its physiological effects and the therapeutic benefits, if any, to be derived from it (Wallace, 1970; Wallace & Benson 1972). Since the physiological state invoked by TM is essentially the same as the one which has come to be called the Relaxation Response it will be discussed in the following section.

The Relaxation Response. Herbert Benson, a medical doctor from Harvard Medical School and Beth Israel Hospital, has described a phenomenon called the Relaxation Response - a calm, relaxed state, that can be invoked in the human body by a set of simple procedures that have been part of the meditational (including Transcendental Meditation) or devotional exercises of various religions (Christian, Buddist, Hindoo, etc.) and philosopies (both Oriental and Occidental) extending back for many centuries in human cultural history. Researching the psychological and physiological consequences of repeated invocation of this calming state, he has found that marked reductions of the physiological correlates of stress and anxiety can occur and that these reductions can be greater than those seen in outright sleep (Benson, 1975). He and a colleague, Ruanne Peters, have also published data in the Harvard Business Review (Peters & Benson, 1978) that indicate that a regular inducement of this state in place of the traditional coffee break leads to improved health and job performance in industrial workers (as measured by blood pressure and self reports of ability to concentrate and handle problems).

Autogenic Training (AT). AT is a system of exercises utilizing passive concentration to free the natural, homeostatic, curative processes of the body to restore it to a healthy equilibrium in the face of stress, fatigue, or the actions of agents of disease. Since before the turn of the century, Schultze, and later his student Luthe, have been perfecting these exercises and applying them with a notable rate of success to medical patients with various complaints ranging from high blood pressure to respiratory disorders (Luthe, 1969, 1970). There appear to be both general effects relating to improved overall health and psychological relief from anxiety, and specific effects such as increased blood circulation and warmth in the extremities of individuals suffering from a medical syndrome that is characterized by cold hands and feet.

Progressive Relaxation. This is an extensive series of exercises developed many years ago by Edmund Jacobson (1938) the aim of which is to teach the individual to recognize the feeling of muscle tension in both superficial and deeper lying muscle structures. This leads to recognition of previously unperceived states of debilitating and otherwise troublesome tension which then the individual is taught to relieve by bringing action in these muscles under conscious control. Tension has long been known to be implicated in a number of serious medical problems such as high blood pressure and Progressive Relaxation as a therapy has been shown to be helpful to hypertensives (e.g., Graham et al, 1977) as well as other types of medical patients (see Brown, 1977).

The Quieting Response. One of the most widely known practioners of relaxation as a therapy is Dr. Charles Stroebel who has developed a program presented on audio cassettes to teach the individual how to control body tension in stressful situations (see Stroebel, in press). Acquisition of the skill takes considerable time and involves the learning of respiration control techniques and exercises to relax both the skeletal and smooth muscle systems. The goal of the program, to be realized only after training for some months, is for the individual to become able to calm himself quickly and successfully deal with stressful situations with which he formerly would have been unable to cope. These cassettes can be used with biofeedback training to augment their effectiveness.

Biofeedback. A large volume of research has been produced in recent years investigating the potential of biofeedback as a technique of self control and clinical intervention for stress-related problems (see Brown, 1977; Fuller, 1978; and Winer, 1977, for reviews). One of the most interesting programs of basic research in biofeedback is conducted in the lab of Edward Taub, who, working with thermal biofeedback, has shown that, with the aid of biofeedback instrumentation, people can learn to control the temperature in their extremities (Taub, 1977). Furthermore, Taub has shown that once they have developed that ability it can be retained for a period of months.

Stress Coping Training for Skydivers. As described in the preceding sections, Dr. Walter D. Fenz, a skydiving psychologist, has taken knowledge about stress and its mastery, which he and his colleagues have developed during almost 20 years of research on stress in skydivers, and with G. Brian Jones (see Fenz, 1975) applied it to a training program for novice skydivers. This program of mental and physical techniques (e.g., active participation in decision

making and respiration control) produces inexperienced jumpers who, during their critical first jumps and first free-falls show patterns of heart rate response to the events leading up to a jump which resemble those of experienced jumpers and differ significantly from those of novices equally lacking in jump experience but untrained in the methods of the program.

Respiration Control. Several laboratory studies have indicated that regulating the rate of breathing can serve to reduce physiological and psychological arousal in stressful situations. Brief training to reduce the breathing rate below normal in a stressful situation (the threat of receiving "painful" electric shocks) where the natural tendency of the body is to hyperventilate has been shown by McCaul and his colleagues (1979) to reduce arousal, as measured by skin resistance and finger pulse volume (but not heart rate). as well as self reports of anxiety. Other studies varying both the rate and the depth of respiration have demonstrated that large decreases in heart rate can be produced by deep, slow breathing (Laird and Fenz, 1971; Westcott and Huttenlocher, 1961).

Even this partial listing of techniques of this nature which are now thought well of by scientists and reasonably well validated will serve to illustrate the great range of techniques presently available and how they are distributed along dimensions of their therapeutic specificity and the time required for their application. These methods, in their effects, range from the general to the specific. Autogenic Training, for instance, with its mainly non-specific exercises (e.g., mentally repeating to oneself - "my right arm is heavy" or "my right arm is warm") induces deep changes within the body to effect a state that is generally therapeutic and can cause remission of symptoms from a variety of ailments through some not-yet-well understood strengthening of the recuperative powers of the body. It also, however, can apparently effect highly specific changes in localized areas of the body such as in changing the rate of stomach motility in patients with gastrointestinal disorders. Then, too, Autogenic Training with its power to effect general long-term changes in the body can be contrasted with a technique such as respiration control which has more short-lived superficial effects on the body's alarm systems and the perception of threat.

These two methods also will serve as examples of the great contrast in time involvement they require to establish their effects. To begin to see useful effects from AT, it generally requires at the very least, a two week commitment of daily practice (Luthe, Note 1), whereas the technique of respiration control could presumably show effects in not much longer than it takes to tell of it.

Search for the Experimental Technique and an Appropriate Test Environment

Following the exploratory literature search, the experimenter attended workshops in both Biofeedback and Autogenic Training as well as a colloquium on the Relaxation Response in which the technique was taught to the audience. In addition, Dr. Walter Fenz was invited to Fort Benning to present a colloquium on his program of stress-coping techniques for novice skydivers.

Over the same period of time that an appropriate stress-management technique was being selected, a search was underway for the appropriate airborne setting in which to test its effectiveness. For this purpose the experimenter personally went through airborne training at Fort Benning and also observed or accompanied various airborne and airborne-ranger training operations. This background knowledge of the range of training environments in which the chosen technique would be evaluated guided the selection of the technique itself.

As mentioned earlier, both Biofeedback and Autogenic Training have been shown to be effective clinically in certain settings, but each of them requires a large input of time and concentration relative to the amount of time that would be available for that purpose to individuals in the various airborne courses at Fort Benning. Also, the amount of fatigue which they experience during training would make both Biofeedback and Autogenic Training difficult to carry out successfully. The training sessions for both, in fact, involve periods of quiet, relaxed concentration which are certain to put tired individuals to sleep in short order. Furthermore, the minimal time of daily application for either techniques to begin to show any effect at all is just at or beyond the number of weeks that individuals spend in the airborne courses from which it was most likely that the subjects for this study were to be drawn.

The Relaxation Response is quickly learned and applied and given promise as an aid to the airborne soldier in energy conservation during long flights into a drop zone as described in the Introduction to this paper. However, such flights are not common in peacetime and establishing the existence of treatment effects presents difficult measurement problems.

Because it was developed from basic research on the stress of parachuting, the system of stress-management training initially holding the most promise for military application was Dr. Walter Fenz's program of stress-coping skills for novice skydivers. Reference has been made earlier to the general outlines of Dr. Fenz's program and the results he has attained. The major features of the program by which beginning skydivers are prepared for their first jumps are as follows:

Prior to their first jump individuals are hooked up to a biofeedback apparatus which monitors their heart rate. They are then taught a pattern of slow, deep breathing which has been shown experimentally to reduce the heart rate as much as 30 beats per minute (Laird and Fenz, 1971; Westcott and Huttenlocher, 1961) and shown the effect it can have on their own heart rate. Sometime later they are chuted up, taken up in the aircraft that they are to jump from later in the day, and given an in-the-air orientation to the actual conditions preceding a jump. They do not actually jump at this time but are returned to the ground and allowed to disembark. Later in the day, after their jump training is complete, they are then taken up once again to make the actual jump. During this flight up to altitude to make the actual jump, their heart rate is monitored and as it rises they are advised to practice the respiration control technique which they had previously been taught. In addition, to reduce anxiety-provoking uncertainty, they are kept

busy and mentally active by being shown check points on the ground and being asked to make decisions about such things as altitude, wind drift, and the proper exit point, which will insure that they land at the desired point on the drop zone after they jump. These procedures aim at giving them control over the level of their physiological arousal and engaging them cognitively in the decision-making process to prevent them from turning inward and ruminating on their fears. As mentioned earlier, application of these procedures results in a significant reduction of heart rate during jump operations for experimental groups relative to controls. Previous research by Fenz and his colleagues has indicated that lower heart rates while flying into the drop zone precedes better performance during jumps.

At the same time that Dr. Fenz's program was being investigated and coming to be considered the experimental technique of choice, the Jumpmaster Course at Fort Benning was being evaluated as the appropriate test environment for the selected technique. The Jumpmaster Course provides some of the most favorable conditions in which to test a program of stress-management techniques since performance in this course is graded by instructors in an aircraft in flight with the students under extreme time pressure to complete a series of critical actions and inspections which prepare other men, equipment, and themselves for an airdrop. Only a brief association with jumpmaster students prior to their boarding the aircraft to make those graded training jumps is necessary to convince the observer that performance in the Jumpmaster Course is a stressful experience for most men. The stress appears to be the result of a combination of both harm anxiety and failure anxiety (Basowitz et al, 1955). Although most of the men in this course are experienced parachutists they have had little experience at working around the open door of an aircraft in flight and an initial apprehension about that experience must be overcome. Failure anxiety appears to be the prime stressor in the course, however, since these men, in the main, are highly motivated to do well in whatever training they attempt, and critical and irretrievable errors causing their failure from the course can be committed in seconds. The in-flight grading procedures used in this course are extensive and highly detailed and can serve as suitable performance measures against which to test the efficacy of any stress-management techniques. Much of Fenz's program to reduce stress, however, is already incorporated into jumpmaster training curriculum - i.e., the students in that course are given orientation flights and expected to engage in thought and decision making processes during the most stressful portions of the course. Consequently, a replication and extension of the Fenz research with jumpmaster students was neither possible nor desireable.

Selection of the Experimental Technique

For the following reasons, Respiration Control was chosen as the experimental stress-management technique to be evaluated in this study:

(1) It has been demonstrated in laboratory studies to produce large changes in heart rate, a leading indicator of the amount of stress, (2) it figured prominently in a stress-management program in an applied setting involving parachuting (the Fenz research), and (3) it is quickly taught and applied.

Selection of the Test Environment

Stress and Performance as Criterion Measures. The prime consideration in selecting an appropriate airborne environment in which to test the effectiveness of the chosen stress-management technique was under what circumstances could the effect of the treatment be reliably and validly measured? The experimental technique of respiration control had been selected partially because of its use in the Fenz - to what extent are heart rate and performance under stress related - the criteria of greatest interest for this study were level of stress and quality of performance during airborne operations. There was a need to define measures that reflected those dimensions faithfully and to choose a training situation in which they could be taken.

Likelihood of Honest Application. Another consideration of critical importance was the need to do the evaluation with individuals who would take the training in the technique seriously, believe in the possibility that it might help, and give it an honest application. It would be absolutely critical for the interpretation of the outcome of the experiment and the strength and value of the chosen method that the individuals selected to be taught it should actually practice it prior to entering the stressful situation and actually use it therein.

The Jumpmaster Training Course. The field environment finally chosen to install and evaluate Respiration Control as a stress-management technique was the Jumpmaster Training Course at Fort Benning, Georgia. As mentioned before, this course is one in which the Army trains officers and NCOs to assume the responsibility of preparing and supervising airdrops of personnel and equipment. This course offers conditions which meet the prime needs set forth in the preceding sections--it provides a training environment in which the individual is expected to perform under stress and the potential is there to take adequate experimental measures of both the performance and the stress.

The performance measures come from the very detailed grading procedures of the course itself which provide scores, in terms of points lost, for each aspect of an individual's performance while putting out equipment and jumpers over a drop zone. (No other airborne course provides measures of the performance of participants during actual jump operations.) In addition, measurement of stress variables is facilitated by the fact that performance in the Jumpmaster Course is structured around the condition that there are only two jump doors to an aircraft, therefore, only two students can be graded at once. This, in turn, means that the rest of the class is inactive, waiting to perform, able to apply the stress-management technique, and accessible for measurements on the level of physiological stress which they are experiencing.

Jumpmaster Students. Another factor pointing to the Jumpmaster Course as the test environment of choice was the quality and career orientation of the students themselves. Those who come through the jumpmaster course are mostly aspiring professionals deeply interested in learning another professional skill - one which will bring with it serious responsibilities involving the lives of the men under their care. These men (and an occasional woman) want

to learn the skills, pass the course, and be fully prepared to supervise subsequent airborne operations. They are willing to work hard at anything they believe will prepare them to achieve those goals.

PHASE II

Once an appropriate technique was selected the final phase of the research involved teaching it to troops in an operational setting and assessing its effectiveness in the field.

Method

Research Participants

The men used in this study were the students of one class of the Jumpmaster Training Course, Fort Benning, Georgia, in FY 1980. The class consisted of officers from Captain to 1st Lieutenant and one Warrant Officer, CW2, as well as enlisted men from Sergeant First Class to Specialist 4th Class and one Private First Class. The class was all male and, though the men were primarily Army Rangers, there were several from Army Airborne units, a few Marines, and one Air Force officer.

Facilities and Equipment

Training was conducted in a single C130 transport aircraft flying out of Lawson Field, Fort Benning. All training drops were made at Fryar Field, Alabama.

Procedure

Selection of the Initial Experimental and Control Groups. The initial selection of individuals to be included in the experimental and control groups for the experiment to evaluate Respiration Control as a stress-management technique proceeded as follows:

On inprocessing day, the first day of the course, the class was arranged by the jumpmaster cadre in descending order, by rank, with Captains listed first, followed by Lieutenants, senior NCOs, and so on, down to the lone PFC in the class. The students were then broken down into 2-man teams starting at the head of the list moving down and these teams, usually composed of men of equal rank, worked together throughout the course practicing and performing their skills. It was decided that subjects for this experiment should be matched by rank thereby to control to some extent for differences in airborne and service-related experiences. Accordingly, one man from each of the above mentioned 2-man

teams was selected for inclusion in the experimental group which was to be taught the respiration control technique. Selection within teams was made by the flip of the coin, thereby providing random selection within matched pairs. Since there were 31 individuals in this particular class, the flip of a coin also determined that the odd man (the only PFC) was to go into the experimental group.

The Jumpmaster Course Curriculum. The course is conducted over two full weeks of training. The first week is primarily one of classroom training and hands-on practice at rigging and inspecting various parachute harness arrangements. The second week begins with a day of a written general knowledge exam and two hands-on harness inspection exams and consists from the second day on of flights and jumps over the drop zone.

There are five training jumps in the second week. First, there are both a day and a night orientation jump during which the students are taught to recognize, under both daylight and night-time conditions, the checkpoints on the ground indicating time and distance away from the drop zone. Every student makes a parachute jump at the conclusion of each of those orientation flights which will be designated hereafter as the Day and the Night Orientation Jumps.

During the next flight, one member of each pair of students is graded while performing as a jumpmaster and, after going through a series of commands, inspections, and decisions about position of the aircraft relative to the drop zone, he puts out the door a heavy bundle of equipment (weighing approximately 200 lbs) as well as his partner who is used to represent a line or "stick" of jumpers. When both door bundle and jumper are gone, the jumpmaster himself follows. This is the Door Bundle Jumpmaster routine for what will be referred to, here, as the Day Graded Jump.

Later that day, after night falls, the class flies again and this time every man in the class wears combat equipment and is graded while performing as a jumpmaster. For this routine there are no actual jumpers other than the jumpmaster himself even though the student goes through his routine as though he were giving jump commands to other individuals. This is the Combat Equipment Jumpmaster routine for what will be called the Night Graded Jump.

The final flight takes place the following day (weather permitting) when the remaining member of each team, the one who served merely as a jumper on the Day Graded Jump of the preceding day, is graded while acting as the jumpmaster and he, then, puts out a door bundle, his partner who is now serving as a jumper, and himself.

Grading System for Performance in the Aircraft. Each student, as he goes through his routine serving in his turn as jumpmaster, is closely attended by two members of the jumpmaster cadre one of whom grades his performance and the other records the result. Each student is given a cushion of 30 points out of which he may be penalized for errors in his performance and still pass the course.

If, on any jump, he loses more than 30 points, he fails and leaves the course immediately thereafter. Each of the important actions of the jumpmaster routine is assigned a specific number of points which are lost if the individual either forgets to perform them or performs them improperly. Points lost range from a single point assessed for a weak or late performance of non-critical actions, such as being one second late in getting the jumper away, to a maximum of minus 35 points for failure to perform actions of extreme importance such as hooking up the static line (which automatically deploys the main parachute) - a life-threatening error. Due to the fact that each cadreman was involved in an essential job for each training flight, it was not possible to obtain any estimate of the inter-observer reliability of these grades which are, in essence, judgements about performance. However, both the experimenter and the cadre themselves were reasonably confident of the objectivity and reliability with which they are assigned and despite whatever level of measurement error that may be associated with them, they are the basis upon which men are assigned or denied the responsibilities of airborne missions and the lives of other men.

To avoid any possibility of bias in the scores due to the experiment itself, the cadre were not informed of the names of the members of the experimental group. Furthermore, training sessions for which they were assembled as a distinct group took place after normal duty hours while the cadre were not present in the immediate area.

First Training Session. The experimental group was met by the experimenter for the first time immediately after the last class period of the first day. At that time, they were informed that there was to be an experiment done with their class and that they had been selected, by the flip of a coin, to be included in a treatment group which, if they were willing, was going to be taught a method of deep breathing that could possibly help them during the aircraft phase of the course. To support the notion that the technique might work, all the data regarding respiration control, stress, and performance from the Fenz research was presented and explained for its relevance regarding the potential benefit of the technique to them, personally, during the course. At the end of the session, they were asked to assemble once again after classes later in the first week and all who were willing would be officially included in the experimental group and taught the technique.

Second Training Session. All students initially chosen for the experimental group showed up for the second session and were thereby considered volunteers for the experimental group. At that time, they were taught the following breathing sequence:

INSTRUCTIONS

Sharp intake of deep breath; press diaphragm down gently; hold for 8 seconds; release over 4 seconds; hold without breathing 4 seconds; take one regular breath; repeat from the beginning.

It was related to the group that this method (slightly modified by insertion of instruction about pressing down with the diaphragm) was used by Fenz in training his novice skydivers (Fenz, Note 2) and was also used by him (and a similar technique by others) in laboratory experiments in which heart rate was lowered by as much as 30 beats per minute (Laird & Fenz, 1971; Westcott & Huttenlocher, 1961).

To underscore the potential of this method, they were also informed that breathing techniques closely resembling this one (including the instructions about the diaphragm) are used in various practises of Zen Buddhism including the Zen art of archery (Herrigel, 1953), a form of archery practiced for centuries by the Japanese and widely known to produce archers who perform prodigious feats with a bow and arrow.

The students were asked to practise the technique often prior to the beginning of the training flights during the following week and to try to develop an ability to breathe in that manner without conscious thought, admittedly a difficult goal to achieve.

They were instructed to actually use the technique whenever they were beginning to feel themselves becoming "too tight" for their best performance while they were waiting to go through their jumpmaster routines or to make a jump. Since, as mentioned earlier, only two students could be graded at any one time, the remaining students would have long periods of flight time to bridge while awaiting their turn. It was during these periods and a similar period waiting to board the aircraft prior to a flight that the students were advised to use the techniques. In addition, since it was doubtful that most students would practise the technique enough to be able to do it in the recommended manner without conscious thought, they were told not to deliberately try to breathe in that fashion while being graded on their routines. It was feared that this would have a disruptive effect on their performance and unfairly penalize them relative to the members of the control group. These instructions consequently insured that any effects of the experimental technique would be residual ones from having used it prior to their actual performance.

Data Collection

Two types of data were collected for this experiment: measures of performance and measures of stress. The performance measures were the scores from the graded jumpmaster routines. The stress measures were heart rate measurements made immediately prior to the jumpmaster performances and end-of-course ratings by each individual of the stress he perceived himself to be under during certain key events of the course such as when going through the Door Bundle Jumpmaster routine.

Performance Measures. The performance measures came from the grades, described earlier, given to each individual for his performance as a Door Bundle Jumpmaster and a Combat Equipment Jumpmaster.

Heart Rate Measure. The physiological measurement of stress for this study was heart rate per 15 second period taken from the pulse in the carotid artery under the jaw at the side of the neck. The heart rate measure, while certainly not the only or necessarily the most valid indicator of the stressful condition, was chosen because it was the prime indicator in the skydiving studies (Fenz, 1975) and was, in that program of research, shown to be a labile measure of stress and one that tracked changes in respiration, both up and down, and led the more refractory measure of basal conductance from point to point.

The method of measuring the heart rate by taking the pulse by hand with a stopwatch from the carotid artery was chosen because it was a quick and reasonably accurate method of taking measurements on large numbers of individuals without disrupting their activities or disturbing their equipment, a sensitive point during airborne operations.

The heart rate readings were taken by the experimenter on each individual at that point in each flight into the drop zone at which the men to perform on that pass had risen to hook up their static lines and moved back toward the open jump doors to begin their graded routine. Since the first pass over the drop zone for all training flights was always to put out jumpers who were not in the class, the cue to take the heart rate measure in the first two and all succeeding pairs of students was that, when the jumpers of that pass stood up to hook up, the next two students in line, those who were then the ones seated nearest the open doors, would be measured. The measurement was thus taken while the students being measured were still seated and were watching the performance of the pair that had preceded them.

No difficulties were encountered in finding and measuring the pulses of most students in the aircraft. Some could not be located at the carotid artery and were thus measured at the wrist. For one individual, on one single flight, the pulse could not be located for measurement.

In order to transform these raw heart rate measures into a scale of units by which individuals could be compared, one to another, the final form of the heart rate data was to be change-in-heart rate expressed as percent-of-change from a baseline measure. (See Appendix for raw data.) Baseline heart rate for each individual was established by taking the average of two readings made early in the first week of the course under non-stressful conditions. The first reading was taken in the early morning (0800 hours) of in-processing day, the first day of the course. In order to produce a more stable measure to serve as a baseline for comparisons, a second reading was taken two days later during a break between mid-morning classroom sessions (1000 hours approximately). This second reading was then averaged with the first. The two baseline measures were highly correlated ($r = .79$, $p = .001$). Subsequent heart rate readings, taken under conditions of stress in the second week of the course, were then transformed into measures of percent-of-change from this baseline, thus establishing a comparable zero point for all individuals in the study.

Perceived Stress Measure. At the end of the course, in the morning of graduation day, the surviving class members (some had failed during the graded jumps and had departed) were given a questionnaire asking them to rate, on the scale below the amount of stress which they felt themselves to be under during events such as the two orientation and the two graded jumps:

Not Stressful At All	Borderline	Slightly Stressful	Moderately Stressful	Considerably Stressful	Extremely Stressful
1	2	3	4	5	6

Those individuals who failed during the graded flights and left the course immediately upon returning from the drop zone were given stress questionnaires by the cadre to be filled out before they left or done at home and returned by mail.

Selection of the Final Groups. The initial assignments of students to the experimental group yielded a group of individuals who were at least passive volunteers for the experiment, who attended the training sessions, and knew what to do and when to do it. A question of vital importance, however, for the interpretation of the results of the experiment was did they actually utilize the technique when they came under stress and, if so, to what extent? To insure that for the final data analysis the experimental group contained only those individuals who actually used the technique, questionnaires were distributed after the end of the course asking the experimental group members to rate the extent to which they used the deep breathing technique during the second week of training. The following 4-point scale was used:

Never	A little	Some	A lot
1	2	3	4

In addition, the questionnaire also provided space for free comments about the experiment. From a joint examination of both the extent-of-usage questionnaire and the free comments, augmented by discussion with individuals in the experimental group, it was apparent that the selection of the response "A little" on the above question was a polite way to say that the technique really wasn't used at all.

For those reasons selection of the responses "Never" and "A little" were taken as disqualifiers for inclusion in the experimental group and only those individuals claiming to have used the technique "Some" (six respondents) and "A lot" (two respondents) were included in the final experimental group. One individual from the initial experimental group who failed the course and didn't fill out the post-course usage questionnaire was retained in the final experimental group. In a similar manner, the final control group was constituted according to how they responded to a questionnaire which asked them what techniques, if any, they may have used to "psych themselves up" or calm themselves down prior to performing as jumpers or jumpmasters. Three of the control group students, including one who wrote as though his personal technique would be hard to believe, reported that they used slow breathing to help them during the stressful parts of the course and they were dropped from the control group as a consequence.

The final matching of the reduced list of experimental subjects with that of the controls was accomplished by starting with the PFC at the bottom of the list and, proceeding upward, retaining all the original pairs matched by rank which had survived all deletions and by creating new pairs where an experimental student had lost his old pair by his having either failed the course prior to the aircraft performance phase or been disqualified for having used slow breathing on his own. New pairs were made by matching unpaired experimentals with unpaired controls higher up the list, therefore, with a man of equal or, quite often, slightly higher rank. Individuals who failed during the aircraft phase for which the stress-management technique was intended were retained in the experiment and their data were analyzed along with the rest.

After deletion of individuals from the experiment due to classroom failures, jump injuries, and questionnaire responses, the final list contained nine pairs of individuals with two eligible control group individuals unpaired and unused.

RESULTS

The data from the three criterion variables for the comparisons between the experimental and the control groups are summarized in Table 1.

Heart Rate Differences

From the top section of Table 1, it can be seen that heart rates, expressed as percent change from baseline, were, at the time of measurement, lower on average, for the experimental students than for their matched controls for every training jump in the course.

Uncertainty about the actual level of measurement represented by scores on this and the remaining criterion variables, led to the choice of nonparametric statistic, the Wilcoxon matched-pairs signed-ranks test for the analysis of all the data in Table 1 and all analyses were done using the SPSS computer program for that technique (Nie and Hull, 1977). Wilcoxon tests on the heart rate data from each jump established that the experimental group had heart rates significantly lower ($z = -1.78$ and -1.96, $p = .04$ and $.03$, 1-tailed test, respectively) than their matched controls for both of the two night jumps but the differences between the groups on the day jumps were not significant.

The differences in the number of individuals in the groups over the jumps reflects, for the Day Orientation Jump, the inability to find a pulse on one of the experimental students while, for the Day Graded Jump, the differences result from the fact that two of the experimental students failed the course on the Night Graded Jump in what was, for them, their first and only performance as a jumpmaster. Thus, they were never tested as Door Bundle Jumpmasters during the day flight.

Table 1

MEANS AND STANDARD DEVIATIONS OF HEART RATE CHANGE, PERCEIVED STRESS, AND POINTS LOST IN EXPERIMENTAL AND CONTROL GROUPS AND NUMBER (N) IN EACH GROUP OVER FOUR TRAINING JUMPS

	DAY ORIENTATION JUMP			NIGHT ORIENTATION JUMP			DAY GRADED JUMP (Door Bundle Jumpmaster)			NIGHT GRADED JUMP (Combat Equipment Jumpmaster)		
HEART RATE CHANGE (Percent change from baseline)												
CONDITION	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Experimental	14.6	15.7	8	29.4*	18.4	9	30.9	18.8	7	30.8**	13.2	9
Control	19.4	17.2	8	43.8	17.6	9	36.7	13.9	7	38.2	14.3	9
PERCEIVED STRESS												
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Experimental	2.4	1.3	8	2.6	1.4	8	3.9	1.7	7	3.6	1.8	8
Control	2.9	1.5	8	2.8	1.5	8	4.6	1.0	7	3.9	1.1	8
POINTS LOST												
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Experimental	-	-	-	-	-	-	3.6	4.0	7	15.6	11.0	9
	Not Graded			Not Graded								
Control	-	-	-	-	-	-	6.9	6.3	7	11.2	9.7	9

*Experimental group significantly lower than control group, p = .04, Wilcoxon matched-pairs signed-ranks test.
**Experimental group significantly lower than control group, p = .03, Wilcoxon matched-pairs signed-ranks test.

Perceived Stress Differences

Though the experimental group as a whole rated itself as being under slightly less stress than did the control group during each jump the differences were not significant.

The number of individuals listed for these comparisons is eight because one of the experimental students failed the course on a night flight. He departed the post without filling out the perceived stress questionnaire and failed to return a questionnaire sent to him by mail.

Performance Differences

Only the last two jumps listed in the table were graded and for neither jump was there a significant difference between the two groups in performance. For the Day Graded Jump, the experimental group, now reduced by two individuals who failed earlier, averaged considerably fewer points lost than the control group. Although nonsignificant, ($z = -1.26$, $p = .10$, 1-tailed test) this comparison suffered from the low number of individuals involved and the difference obtained is suggestive of a treatment effect.

On the Night Graded Jump, two experimental group members did poorly enough to fail and the higher average for points lost of the group reflects those failures.

Interrelationships among Stress and Performance Variables

A basic question which must be answered in interpreting the above data and establishing the value of respiration control as a stress-management technique is to what extent is stress, as measured by heart rate and self report, related to performance in the aircraft? To begin to answer this question the data for all members of the class, experimentals, controls, and those not included in either group, were used to compute correlations among three classes of criterion variables - heart rate, perceived stress, and points lost during performance. The analyses indicated very little relationship among the three classes of variables. The only significant correlations were between perceived stress during the Day and the Night Orientation Jumps and heart rate during the Night Graded Jump made in the evening of the following day. Pearson product-moment correlation coefficients were $r = .41$, $n = 25$, $p = .02$ and $r = .40$, $n = 26$, $p = .02$, respectively, between the perceived stress variables from the orientation jumps and heart rate during a later graded jump.

To look more deeply into the interrelationships among these variables and how they might be altered as a function of experimental condition, separate correlations were done on the data from each experimental condition.

The control group data very closely resembled that for the group as a whole with the perceived stress of the Day Orientation Jump significantly related

to heart rate during the Night Graded Jump ($r = .58$, $n = 10$, $p = .04$), and stress during the Night Orientation Jump related to heart rate, though not quite significantly ($r = .50$, $n = 10$, $p = .07$). In addition, for the control group, perceived stress during the Day Orientation Jump was related to heart rate during the Day Graded Jump the following day ($r = .54$, $n = 10$, $p = .05$).

The relationships among the variables for the experimental group are very different, however. The relationship involving the perceived stress of the orientation jumps and the heart rate during the Night Graded Jump was not seen in the data from the experimentals alone. However, for those individuals, there were significant, though surprising, relationships among all the criterion variables for the Night Graded Jump, a jump during which the heart rate of the experimentals was significantly lower than that of the controls. Perceived stress during that jump was inversely related to the heartrate during the actual jump ($r = -.64$, $n = 9$, $p = .03$). That heart rate measure in turn was inversely related to number of points lost during the exercise ($r = -.65$, $n = 10$, $p = .02$). This would indicate that to the extent that these relationships hold (approximately 42% of the variance in each case), when heart rate is high, perceived stress and points lost are low. Conversely, when heart rate is low, perceived stress and points lost are high.

These relationships are shown in Figure 1 where, for each individual in the experimental group, the joint scores of both points lost with heart rate and perceived stress with heart rate are plotted. Scores of the same individual are connected by a line in that chart. For the scores of the individuals who both had a heart rate increase of 29% of baseline, the one who lost only six points scored the experience as a three in perceived stress.

This graph illustrates the relationship discussed above that, as heart rate increases, points lost and perceived stress generally decrease. In addition, it shows that individuals who had the highest increases in heart rate also lost the fewest points and rated the experience as less stressful while at least one of the individuals who had the lowest heart rates (the other failed to complete the perceived stress questionnaire) also lost the most points and rated the experience as most stressful.

Although the correlation is not significant, another inverse relationship for the experimental group which would support the preceding one is the finding that heartrate during the Day Graded Jump is also negatively related to points lost during Door Bundle Jumpmaster routine ($r = -.44$, $n = 8$, $p = .13$).

DISCUSSION

The clearest outcome of this research is that an evaluation experiment of this type conducted in an operational environment is a difficult undertaking. Respiration control was presumably effective in reducing the heart rates of the experimental students relative to the controls on two training jumps, both conducted at night, when, due to limited visibility, parachute jumps are somewhat more dangerous and therefore more stressful. The technique was not, apparently, a great aid to performance in this setting. Only three students performed so badly during the graded jumps that they failed the course as a result - two

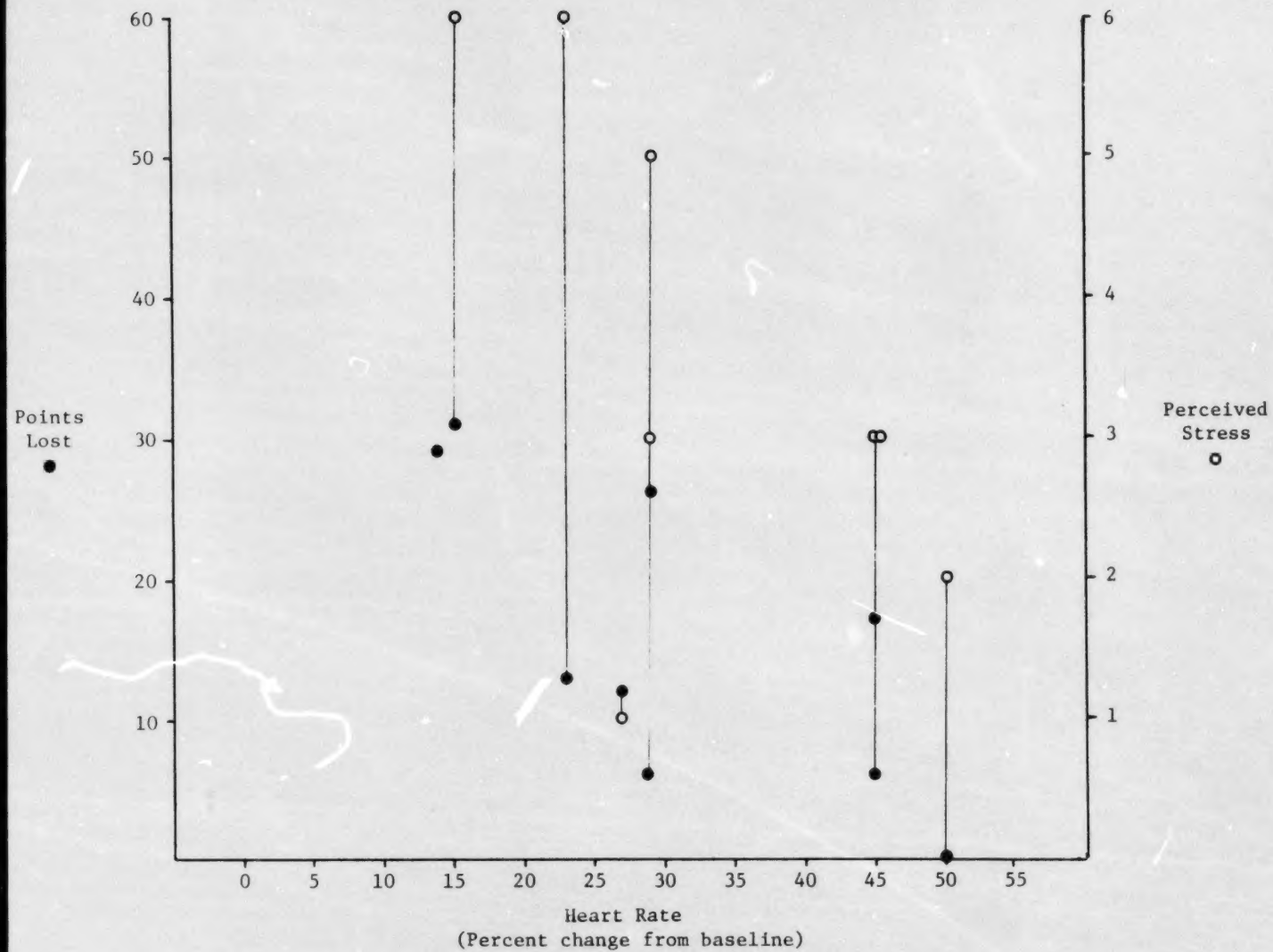

Figure 1. Relationships between heart rate change and each of two measures, points lost and perceived stress, plotted for all individuals in the experimental group. Light lines interconnect scores on points lost and perceived stress variables for each individual.

of them were members of the final experimental group and one had been included in the initial experimental group but was dropped from the final group due to having reported that he used the technique only "a little."

Considering the data from this experiment, overall, it is noteworthy that, for every comparison between the experimental group and their matched controls save one - points lost during the Night Graded Jump - the experimental group, on average, did better than the controls. While there is no statistic appropriate for assessing the statistical significance of this outcome, these results do seem to indicate a possibility that respiration control did have some generally helpful effect.

The most intriguing aspect of the data is the inverse relationship, among the experimental students, between heart rate and both perceived stress and performance. There is no obvious or certain explanation for this outcome but it is possible that the data represent the leading edge of the much referenced, but sparsely documented, inverted-U shaped function hypothesized to relate performance and arousal (e.g., Hebb, 1955). This hypothesis holds that there is a state of optimal arousal during which performance is also optimal. For states of arousal lower than this optimum, the individual is not sufficiently activated to produce his best performance. For states of arousal exceeding the optimum he is overstimulated to the point that his performance is distrupted as a result.

The data from the experimental group may be interpretable with reference to that hypothesis. As shown in figure 1, individuals who lost the most points on the Night Graded Jump had heart rates which represented the smallest increases relative to baseline in the group while the individuals who lost the fewest points, including one who lost no points, had the greatest increases over baseline. Thus, taking these data, performance goes from poor to optimal as arousal (heart rate change) increases to an optimum. The absence of any data points on the hypothesized down-side of the curve (which would be the up-side for these data where performance is points lost rather than points scored) where increased arousal predicts deteriorating performance, could possibly be explained by the nature of the sample of individuals for this study - men who come for the most part from the elite infantry units of the Army and Marines. Few of these men would be likely to be so overwhelmed by a training experience of this nature that it should bring them to such a state of supra-optimal arousal that they fall completely apart as a result.

Following this line of reasoning, perceived stress might also go down as heart rate increases to optimum, because those individuals who were at optimal arousal and consequently were performing well perceived themselves to be under little stress at the time whereas those doing poorly viewed the experience in the opposite manner. The data from individuals bears out that interpretation since with a single exception as heart rate increases perceived stress declines.

All this, of course, is just conjecture and further research employing better, more immediate measures of stress would be necessary to clarify the nature of the relationship.

Problems with the Research

Placebo Effects. It is possible that the differences in heart rate between the experimental and the control groups during the two night jumps is the result of a placebo effect rather than a consequence of respiration control. This effect would derive from the influence of a professional psychologist who delivers to the men of the experimental group a technique that might be regarded as a sort of scientific talisman to ward off the disruptive effects of nervousness. Men who considered themselves shielded in such manner might be calmer and show a lower rate of heart beat than controls for that reason alone, regardless of their rate of breathing.

This possibility was entertained by the experimenter prior to the study and the inclusion of a placebo effects group was considered. The decision was made, however, not to include such a group because of the questionable ethics involved. The students going through this course practice steadily on their own time each night and over the weekend to prepare themselves to meet their test in the aircraft during the second week. To take them away from that practice or their necessary relaxation to teach them some exercise of deliberate nonsense was considered to be unfair to them and harmful to the credibility of the experimenter in future work of this nature.

To reduce the possibility of a placebo effect, it was repeatedly emphasized to the experimental group members that it was not at all certain that the technique would be effective, especially for improving their performance. To judge from the relatively large number of individuals who reported using the technique only "A little" or "Some," it was apparently not widely viewed as the sort of powerful amulet that would have created a placebo effect in the users.

Problems with the Dependent Measures. The meaning of these results for the interpretation of respiration control as a stress management technique hinges upon the validity and reliability of the dependent variables as accurate measures of stress and performance in this setting. The most obvious shortcoming of the heart rate measurement is that it was taken prior (although just immediately prior) to the point at which the individuals actually stood up from their seats, hooked up their static lines, and moved back to the open door for the moment of truth. That is the point at which many individuals first begin to get noticeably excited. Whether a measure taken before that watershed experience is a valid indicator of a condition which develops later is still an open question. To the extent that it is not, any relationship between heart rate and performance would be obscured.

The perceived stress measure suffers from being a retrospective judgment of amount of stress experienced in the past and as such it is subject to distortion both by memory and by intent. It can also be influenced by knowledge of results, since individuals may report an amount of stress that reflects the number of points they lost.

The greatest difficulty of the performance measure, for the purposes of this experiment on the effects of stress, is that it is influenced by other, more powerful variables such as prior life experiences of a similar nature and amount of after-class practice done on the ground before performing in the aircraft. In addition, there are less tangible but no less important factors such as determination to succeed and excel at the task. One of the experimental individuals who failed the course on the Night Graded Jump reported later to the cadre that when it came time for him to perform the safety check of the surrounding air space that calls for the jumpmaster to hook his heels over the edge of the jump platform outside the aircraft and to lean far out with only the fingers that hold him in place still inside the aircraft, he asked himself the fateful question - whatever made him think he was cut out to be a jumpmaster? When he decided to himself that he was not, his performance deteriorated immediately and he failed out of the course at that point. Just moments before, that student had a heart rate reading that was one of the lowest changes from baseline in the class.

Problems with the Experimental Technique. The method of respiration control chosen for this study was probably too complex for maximal effectiveness in this setting. Although the students were asked to practice it to the point that the rhythm and timing of their breathing could be maintained without conscious thought, it is certain that most of them did not. Consequently, it was probably not being used very often, if at all, when the men were actually going through their routines.

As mentioned before, the method was chosen to provide a direct link with laboratory experimentation (Laird and Fenz, 1971), with applied research (Fenz, 1975) and with a philosophical tradition (Herrigel, 1953) and thus to be perceived by the students as worthy of an honest try. In retrospect, it seems that a better method for use under these circumstances would have been one reported by Westcott and Huttenlocher (1961) involving deep, slow breathing at a regular rate of six cycles per minute. This regime produced reductions in heart rate of up to 30 beats per minute and would be much easier to maintain while thinking of other things.

Respiration Control for Stress-Management

The only judgment which can be given at this time on the effects of respiration control as a stress-management technique is that it apparently worked at times in this experiment to control heart rate and that, although it wasn't established by the evidence here, it is still possible that it was of marginal value in performance. It was, perhaps, the nature of the men who participated in this experiment that worked to obscure whatever power the technique may possess to enhance performance. The Jumpmaster Course was chosen for this research because of the relatively exact performance measures which it provides and because the students who go through the course are, in the main, dedicated individuals who could be depended upon to give the technique a good test. However, they are also, on average, relatively experienced with and competent at training of a demanding nature similar to the activities in this course.

A technique which might have been of considerable benefit to indivuals less adept at performance under such conditions would have a smaller effect for these men and, thus, for that effect to show through all the uncontrolled variability in the scores, would require sample size much larger than the one possible here. This reduced effect was anticipated and, to accommodate it, this research was planned to use three additional classes of Jumpmaster students. A shortage of cadre for the Basic Airborne Course at Fort Benning and the need to divert cadre to it necessitated a prolonged and indefinite termination of the Jumpmaster Course immediately after the class used for this research was graduated. An alternate population of jumpers, the novice parachutists from the Basic Airborne class at Fort Benning, was considered as a replacement but rejected because of the lack of suitable performance measures with which to test the main hypothesis of the research.

In sum, considering all the factors involved, respiration control appeared to be a limited success at controlling one aspect of stress under the conditions of this experiment and, as such, requires further study to establish its usefulness to the military.

Potential of Stress-Management Research for the U.S. Army

All the techniques investigated in Phase I have been described by their proponents in general terms as methods of stress-management. Given this broad range of what are, in effect, self-applied methods for the control of involuntary stress, it would seem that it might be a matter of some interest to the U.S. Army to investigate the potential of these programs as aids to human performance in stressful situations. If a number of them were to fulfill their promise in applied settings, it might be possible, in the long term, to offer the professional soldier a wide choice of self-help aids.

As borne out by attempts in this pilot experiment to validate one of the simplest of the techniques available, to select, install, and evaluate such training programs would be a very difficult undertaking and the work of many years. All those methods currently under study or being applied in clinical practice should be reviewed both with reference to the evidence in the current literature as to their effects and, also with regard to their applicability within the military setting. Then, all of the most promising techniques must be adapted to the military situation and be tested under operational conditions or valid laboratory analogs.

To find stressful training and/or operational conditions of the right dimensions to test each of the individual methods under review would be difficult. There are potentially a number of such situations throughout the U.S. military that might qualify depending upon the particular stress-management technique to be evaluated. Among them are the U.S. Army Airborne, Ranger, and HALO (High Altitude, Low Opening - military skydiving) Schools and the U.S. Navy Submarine, Underwater Demolition Team, and Firefighting Schools. Other sources of both men and women performing in stressful situations are the many skydiving teams and clubs that currently abound throughout the Army. In addition, any units engaged in training in continuous operations such as that to be conducted at the future National Training Center would be candidates for a test of the potential restorative powers of some of the techniques mentioned earlier.

The actual details of any evaluation research done upon any of the candidate methods would vary greatly depending upon the particular method under consideration, the population to which it is applied, and the setting in which it is evaluated. The difficulties of this research would be great. From among the many techniques currently being investigated or promoted, sound techniques must be located, adapted, and implemented within organizations that exist for other, more immediately pressing purposes. It would be very difficult to get busy or scared men to devote the attention and effort required so that the programs receive good and fair tests. Experimental control would be hard to maintain in the fast-moving confusion of actual training events. The techniques may not work, or if they do work, the dependent measures may not show it. In short, the risks of this line of inquiry are high. The payoffs, however, should they come, would be commensurate.

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APPENDIX

RAW HEART RATE DATA (BEATS PER 15 SEC.) FOR EXPERIMENTAL AND CONTROL GROUP SUBJECTS AT REST AND IMMEDIATELY PRIOR TO FOUR TRAINING JUMPS.

SUBJECTS	Rest 1	Rest 2	Rest Ave.	Day Orient	Night Orient	Day Graded	Night Graded
EXPERIMENTAL GROUP							
1	24	28	26	24	28	-	30
2	15	14	14	16	21	20	18
3	19	17	18	18	18	20	22
4	16	15	15	19	17	21	19
5	15	13	14	16	19	-	16
6	12	11	11	16	15	17	16
7	14	15	14	-	20	20	21
8	18	18	18	21	27	21	26
9	18	16	17	15	22	18	22
CONTROL GROUP							
1	19	18	18	20	26	-	21
2	15	15	15	16	20	21	20
3	16	14	15	16	20	17	19
4	16	17	16	17	23	23	20
5	15	15	15	17	17	-	21
6	16	15	15	18	25	21	21
7	13	16	14	-	19	18	22
8	15	16	15	23	25	23	24
9	18	15	16	22	25	21	23

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